UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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*Ex parte* TAMMY ZHENG,
CALVIN TODD GABRIEL and
SAMIT SENGUPTA

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Appeal 2007-3019
Application 09/775,370
Technology Center 2800

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Decided: December 7, 2007

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Before JOSEPH F. RUGGIERO, ROBERT E. NAPPI
and KEVIN F. TURNER, *Administrative Patent Judges*.

TURNER, *Administrative Patent Judge*.

## DECISION ON APPEAL

## STATEMENT OF CASE

Appellants appeal under 35 U.S.C. § 134 from a final rejection of claims 27 through 37. We have jurisdiction under 35 U.S.C. § 6(b).

Appellants disclose a semiconductor device having interconnect lines through vias that allow for connections between metal layers to be formed. The formation process for the semiconductor enables the prevention of the formation of voids in the metal plugs that make up the interconnect lines. (Specification 1: 6-9).

The independent claim 27, which is deemed to be representative, reads as follows:

> 27. A semiconductor device comprising:
>
> a first metal portion over a substrate;
>
> a dielectric layer above the first metal portion;
>
> a second metal portion above the dielectric layer;
>
> a single-layer aluminum alloy plug extending from the first metal portion through the dielectric layer to the second metal portion, the plug having a first upper surface extending laterally beyond the second metal portion and substantially planar to an upper surface of the dielectric layer and a second upper surface that extends above the first upper surface.

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

| | | |
|---|---|---|
| Green | US 4,851,895 | Jul. 25, 1989 |
| Korman | US 5,959,357 | Sep. 28, 1999 |

The Examiner rejected claims 27-37 under 35 U.S.C. § 103(a) as being unpatentable over Korman and Green. In the Final Office Action, claims 28-32 and 34 were rejected under 35 U.S.C. § 112, first and second paragraphs, but those rejections were withdrawn in the Examiner's Answer. (Answer 3). Appellants indicate that all of the claims stand or fall together, (Br. 3), and we take independent claim 27 as representative.

Appellants contend that the Examiner erred in indicating that the claimed subject matter would have been obvious. More specifically, Appellants have argued that (1) the Office Action failed to show that the cited references teach or suggest every element of the claimed invention, (2)

the rejection is guided by improper hindsight reasoning, and (3) the proposed modification of Korman would render that reference unsatisfactory for its intended purpose. (Br. 4-8). The Examiner finds that the cited references teach or suggest all of the elements of the claims and the motivation to combine the cited references is sufficient to find the claims to be obvious. (Answer 6-12).

We affirm.

## ISSUE

Have Appellants shown that the Examiner erred in establishing that the combination of the cited references teaches or suggests all of the disputed elements of independent claim 27?

## FINDINGS OF FACT

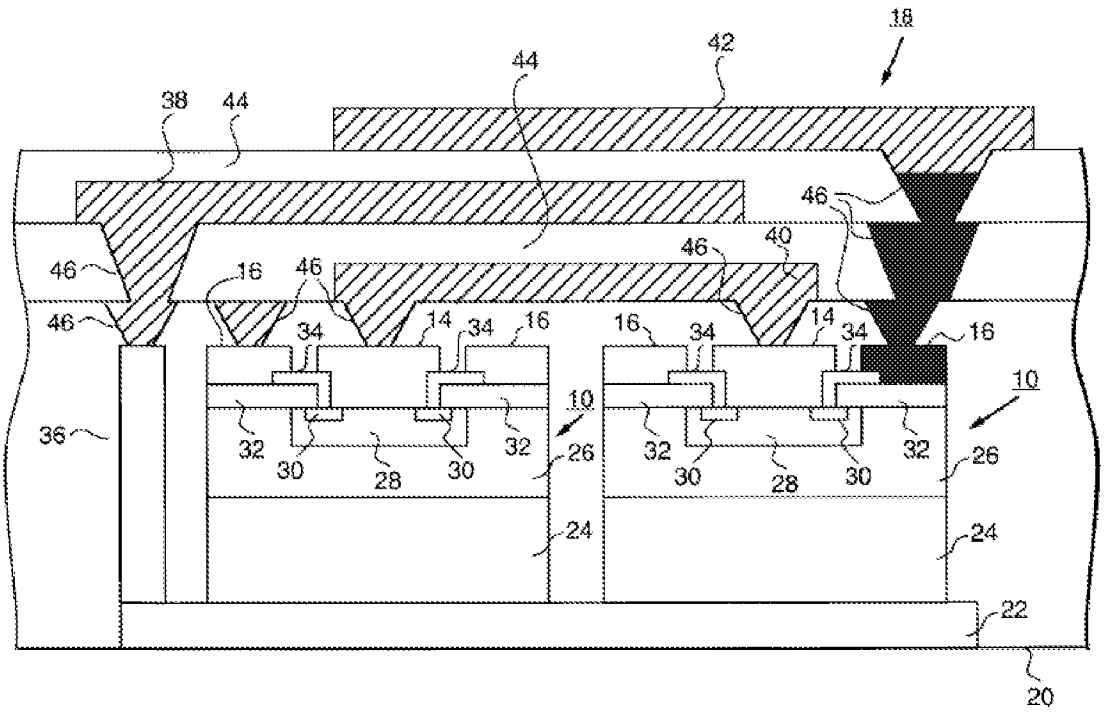
1. The application provides a solution for the problems that can occur when there is not complete overlap of metal structures. Because of subsequent etching steps, voids can be formed in the plugs that make up the interconnects. The application discloses that vias are formed that pass through a dielectric layer to a first metal portion. An aluminum alloy plug is formed in the via to allow for an interconnect between the first metal portion and a second metal portion. (Specification 7:5-15 and 14:1-10; Figs. 1c and 2c, elements 110, 130, 140, 210, 220, 240 and 255).

2. Claim 27 provides that the aluminum alloy plug is "a single-layer," but the Specification does not provide a definition of "single-layer." The formation of the plug is described wherein "[t]he metal layer 240 formed over the barrier layer 235 and with via 220 may be formed in a single step,"

and "[a]lternatively, the via 220 may first be filled with a metal material and then, using the same or different formation conditions (e.g. deposition rate or temperature), the metal layer 240 may be formed over the barrier layer 235." (Specification 10:25 – 11:2).

3. Korman discloses a field effect transistor (FET) arrangement that includes three metallization layers for the gate, drain and source terminals thereof. The layers include a gate runner metallization layer that allows the FETs to be arranged in a parallel manner so as to reduce the overall total on-state resistance to an optimum value, while allowing the gate switching capacitance to be increased to an optimized value. (Abstract).

4. Korman Fig. 3, with added emphasis, is reproduced below:




Korman's Fig. 3 illustrates the FET arrangement, with areas of particular interest shaded. A source or drain terminal (16) is connected to a third metallization layer (42) through a three-step via (46). The three-step

via passes through layers of polyimide dielectric (44). The stepped nature of the metallization has portions that extend laterally beyond other portions and also has portions which are substantially planar to upper surfaces of the polyimide dielectric layers. Korman discloses that the third metallization layer is composed preferably of copper. (Col. 5, ll. 19-24 and 36-51; Fig. 3, elements 16, 42, 44 and 46).

5. Green describes processes for metallization for integrated devices using ruthenium as a metallization material. Green discloses that the suitability of a material as a metallization material depends on a number of materials properties such as, e.g., electrical conductivity, electrical contact resistance, stability of such electrical properties over time, physical integrity and adhesion, and the availability of a suitable etchant in photolithographic processing. It lists that among such metallization materials are gold, aluminum, alloys of aluminum and copper. (Abstract; col. 1, ll. 21-30).

## PRINCIPLES OF LAW

The Examiner bears the initial burden of presenting a prima facie case of obviousness. *In re Oetiker,* 977 F.2d 1443, 1445 (Fed. Cir. 1992). If that burden is met, then the burden shifts to the Appellants to overcome the prima facie case with argument and/or evidence. *In re Mayne*, 104 F.3d 1339, 1342 (Fed. Cir. 1997). The analysis need not seek out precise teachings directed to the specific subject matter of the claim but can take into account the inferences and the creative steps that a person of ordinary skill in the art would employ. *KSR Int'l Co. v. Teleflex Inc.,* 127 S.Ct. 1727, 1741 (2007).

Although claims of issued patents are interpreted in light of the specification, prosecution history, prior art and other claims, this is not the mode of claim interpretation to be applied during examination. During examination, the claims must be interpreted as broadly as their terms reasonably allow. *In re American Academy of Science Tech Center*, 367 F.3d 1359, 1369 (Fed. Cir. 2004). It is the use of the words in the context of the written description and customarily by those skilled in the relevant art that accurately reflects both the "ordinary" and the "customary" meaning of the terms in the claims. *Ferguson Beauregard/Logic Controls, Div. Of Dover Resources, Inc. v. Mega Systems, LLC*, 350 F.3d 1327, 1338, (Fed. Cir. 2003).

ANALYSIS

Appellants argue that Korman discloses a two-layer plug that cannot be a single plug, that the upper portions of the plug in Korman would apparently have been formed after the lower portions and the single plug is comprised of separate vias. We agree with the Examiner, in that the term "single plug" should be interpreted as an electrical connection having one part that connects two integration levels. (Answer 6). There is nothing in Appellants' Specification that contradicts this definition and the Specification makes clear that the single-layer aluminum alloy plug can be formed in two steps. (Finding of Fact 2). As such, we agree with the Examiner that portions of the metallization of the three-step via are analogous to the single-layer aluminum alloy plug.

Appellants also assert that the upper surface of a section of the plug is not planar with an upper surface of the dielectric layer. Given that a portion

of the plug is coplanar with an upper level of the dielectric, (i.e. the plane upon which the upper section of the second metallization layer (38) rests), we find this aspect of claims 27 to be taught by Korman.

Appellants argue that the plug in Korman must have an interface between multiple vias and the Office Action's rationale that the plug does not exhibit any interface is unsupported. We agree, however, with the Examiner that there is nothing in the disclosure of Korman that teaches any interface, border, division of physical boundary that would suggest that the plug is not a single plug. Even if the plug were formed in separate deposition steps, we do not find this to be distinguishing from Appellants' disclosure since the via in the instant disclosure may first be filled with a metal material and then, using the same or different formation conditions, the rest of the metallization may be formed. (Finding of Fact 2). While Appellants could argue that their multiple step process, under different conditions, does not provide an interface and that any process that can be used to form the metallization structure in Korman would have to produce an interface, we find such arguments to be without merit.

Appellants also argue that the problems of the prior art disclosed in the Specification have not been considered and the use of copper for the metallization in Korman would not suggest the use of an aluminum alloy to one of ordinary skill in the art. Appellants also argue that the Examiner's interpretation that copper and aluminum are interchangeable is not supported. Upon review of the prosecution of the instant application, it is clear that the Examiner has considered the disclosed problems of the prior art and provided them with the proper deference. Korman need not suggest

the use of an aluminum alloy, since the rejection relies on the teachings of Green to provide the motivation for this alternative. We do not find that the Examiner is suggesting the interchangeability of copper and aluminum; the Examiner has applied the teaching of Green that the suitability of a material as a metallization material depends on a number of materials properties. (Finding of Fact 5). Additionally, we agree with the Examiner that Appellants' Specification teaches that both copper and aluminum can be used as interconnection materials.

Appellants also allege that the problems addressed by the cited prior art and the claimed invention are entirely different and thereby rebut any argument that a skilled artisan would be led to implement the modification as asserted. As discussed above, we find that the Examiner has considered claim 27 as a whole and the teachings of Green provide adequate motivation to make the suggested modifications to Korman. Additionally, the problems solved by the combination of Korman and Green and the presently claimed invention need not be the same; it is sufficient that the Examiner has proffered a prima facie case of obviousness that teaches of suggests all of the elements of claim 27.

Lastly, Appellants argue that the modification of Korman in view of Green would render Korman unsatisfactory for its intended purpose. Appellants allege that Korman teaches the grouping of discrete FET elements and the instant application is directed to monolithic IC design and solving its interconnection challenges. The fact that the purposes of the invention in Korman and the instant application are different does not render Korman unsatisfactory for its intended purpose. Appellants have not argued

that the use of aluminum alloys, as taught by Green, in the structure of Korman's devices would render Korman's devices to be unsatisfactory for their intended purposes.

## CONCLUSION OF LAW

We conclude that Appellants have not shown that the Examiner erred in rejecting claims 27 through 37 and we affirm the Examiner's rejections under 35 U.S.C. § 103(a) as unpatentable over Korman and Green.

## DECISION

The decision of the Examiner is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

KIS

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